

Groundwater geochemistry and isotope study of groundwater recharge in the shallow and deep alluvial aquifers of semi-arid agricultural region, Punjab, India.

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In agricultural regions groundwater is mainly used for irrigational purposes, overexploitation of groundwater has led to water quality deterioration. In the current study, work has been carried out to understand the groundwater geochemistry of shallow and deep wells and to know the effect of irrigation on water quality. Groundwater samples have been collected from the agricultural state of Punjab during the pre-monsoon season and have been analyzed for major chemical parameters. Analytical results show that $\text{Na}^+\text{-HCO}_3^-$ is the dominant groundwater type in deeper aquifer whereas shallow groundwater has both Na^+ and Mg^{2+} bicarbonate type of water. Order of abundance of ions in both the aquifers is $\text{Na}^+ > \text{Ca}^{2+} > \text{Mg}^{2+} > \text{K}^+$ and $\text{HCO}_3^- > \text{Cl}^- > \text{SO}_4^{2-} > \text{NO}_3^-$ for cations and anions respectively. The change in groundwater type with depth is attributed to the changing characteristics of groundwater with flow path and recharge along with the interaction with aquifer minerals. Salinity is higher in the shallow aquifer due to the effect of anthropogenic activities at shallow depth with oxic conditions in both the aquifers. Environmental stable isotopes show the evaporation signature in both the aquifers indicating the contribution of irrigation or evaporated water to the aquifer system. It shows that a connection exists between the shallow and deeper aquifer and warns against the possible contamination of deeper aquifer in the future. Agricultural activities are leading to more quality deterioration and groundwater resources need to be better managed for their long-term usage and sustainability.